



# Cool Structured Loops and Diffuse Hot Plasma Observed in Solar Flares

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- Introduction
- Problem Statement
- Observations
- Analysis Approach
- Results

**Special Thanks for the Web  
Resources of:**

SOHO/LASCO and SOHO/EIT  
(ESA and NASA)

Yohkoh SXT (ISAS)



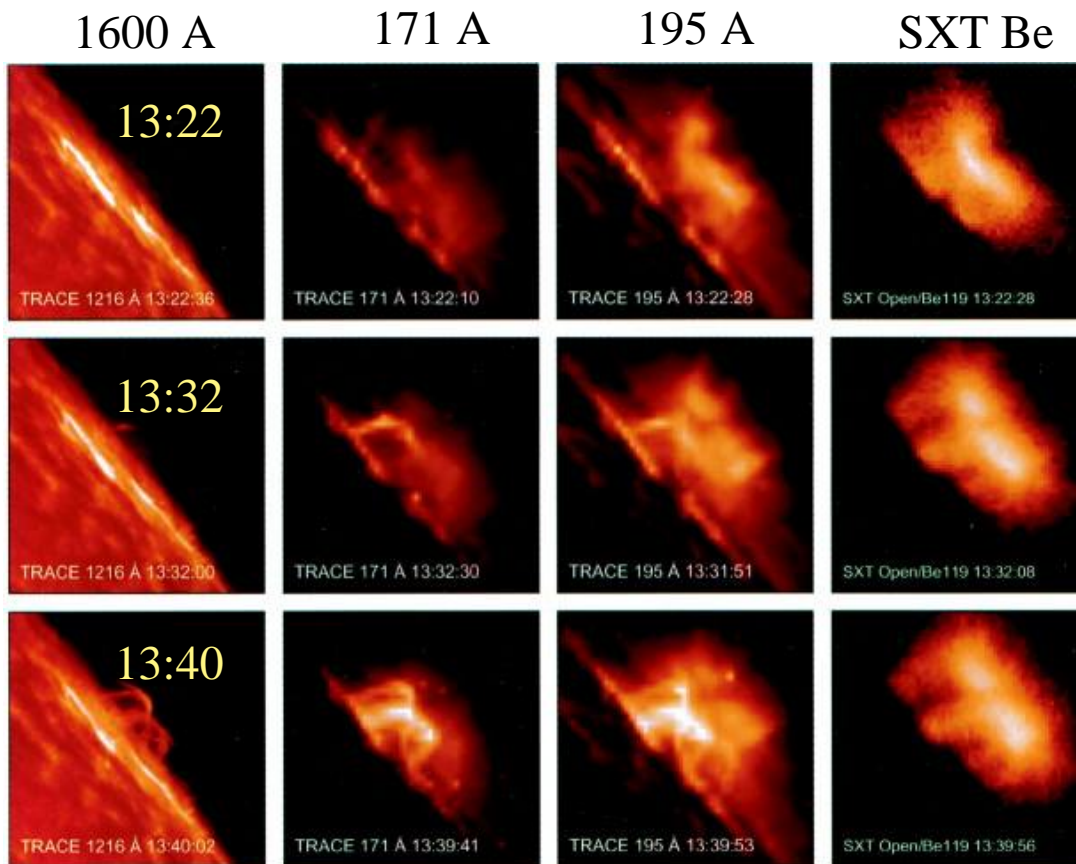
# Post-Flare Loops



- Motivation
  - Post-flare magnetic reconnection and its relation to CMEs is poorly understood.
  - The general model works qualitatively
  - Numerous observed phenomena lack a clear explanation.
  - 3-D effects and viewing geometry complicate the picture
- Caveats
  - We're just getting started - view this as a *progress report*
  - SXI calibrations and uncertainties are still being refined
- Why Apply SXI Data to the problem?
  - Spans the spectral region between EIT and SXT
  - Multi-band coverage
  - Rapid, continuous, full-disk cadence



# Post-Flare Systems Background



Warren *et al.*, 1999

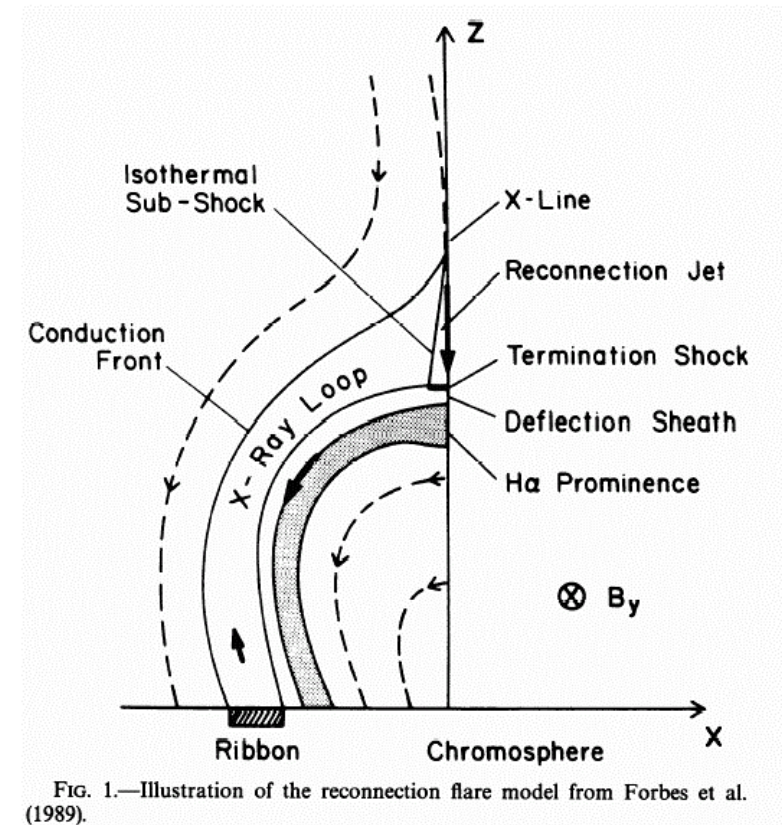


FIG. 1.—Illustration of the reconnection flare model from Forbes *et al.* (1989).

Forbes *et al.*, 1989

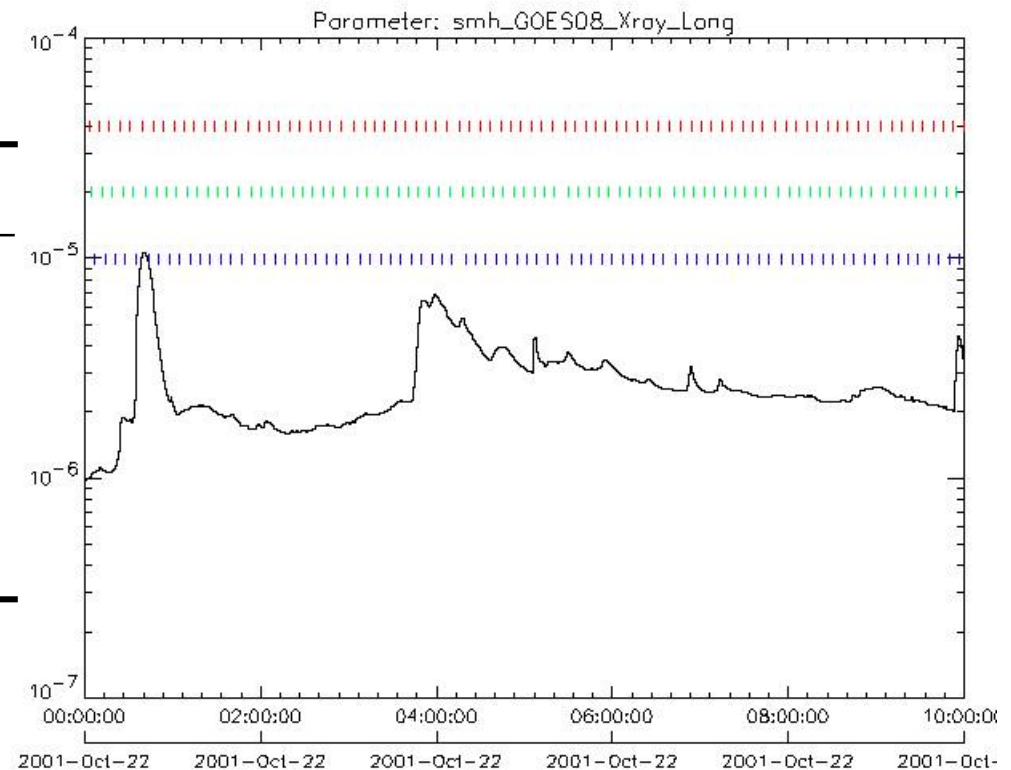


# Observations



- Four limb events under study
- Goodbye LEO eclipses and SAA!
- GOES-12 SXI
- SOHO EIT
- *Yohkoh* SXT

Date	Flare	CME	Location
<b>2001-10-22</b>	<b>C3.3</b>	<b>YES</b>	<b>W Limb</b>
2001-11-01	M3.4	YES	E Limb
2001-11-12	C7.0	YES	E Limb
2001-12-01	M2.2	YES	W Limb

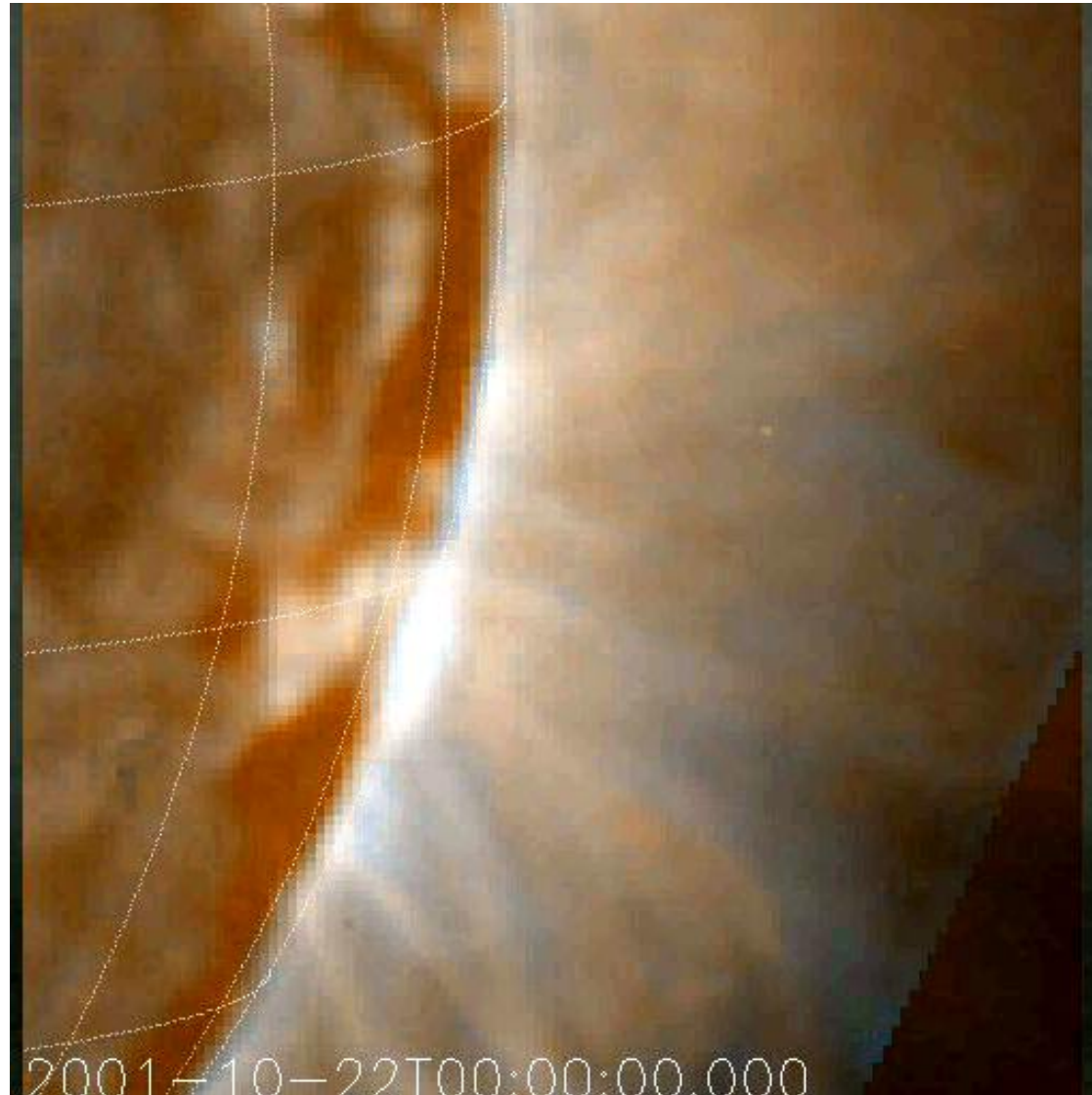




# Phenomenology



- One day synchronized movie of EIT FeXII (reddish) and SXI Open filter (bluish)





# Analysis Approach



- Image comparison to EIT and SXT images
  - SXI image PSF deconvolution
  - Examination of images
  - Synthesized 'low-pass' spectral filters
- Temporal evolution
  - Light curves
  - Centroid of emission
- Filter ratio image analysis
  - Compare SXI data to EIT data
  - Intensity versus emission in SXI

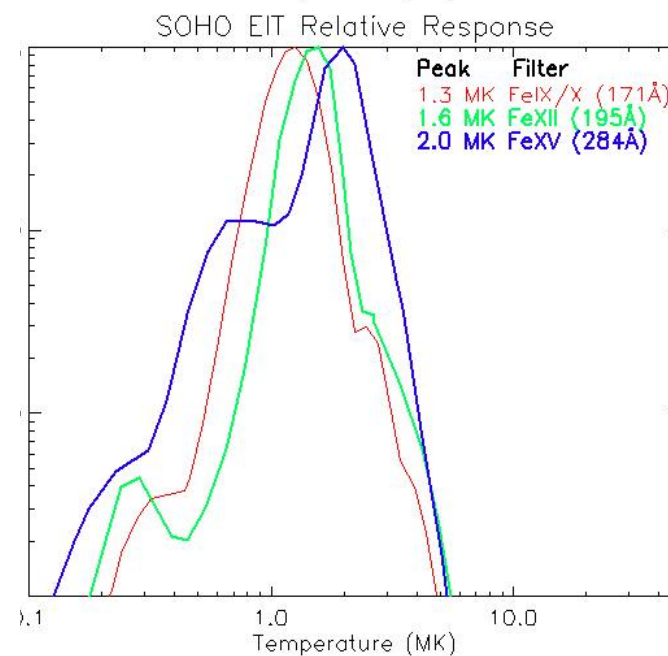
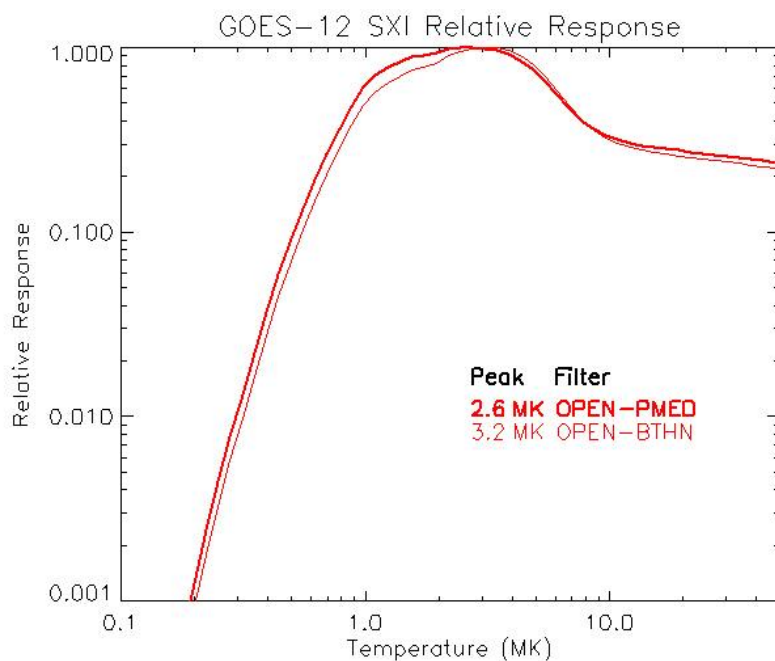
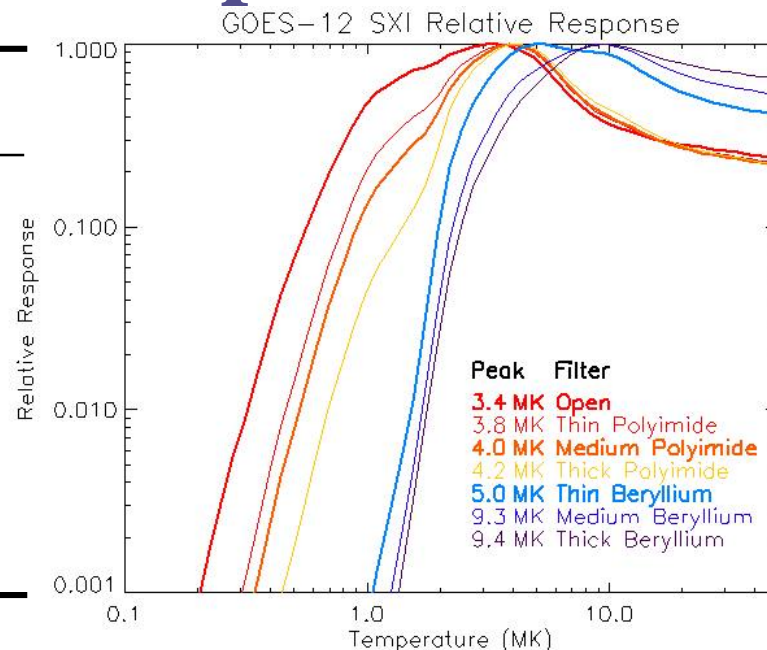




# Response to Temperature



Filter	Peak Sensitivity (MK)
FeIX/X (171A)	1.3
FeXII (191A)	1.6
FeXV (284A)	2.0
OPEN-PMED	2.5-2.6
OPEN-BTHN	2.7-3.2
OPEN	2.9-3.4
PMED	3.8-4.0
BTHN	5.0



EIT  
User's  
Guide



# ‘Cool’ Resolved Loops in **SXI** & **EIT**



1.3 MK

1.6 MK

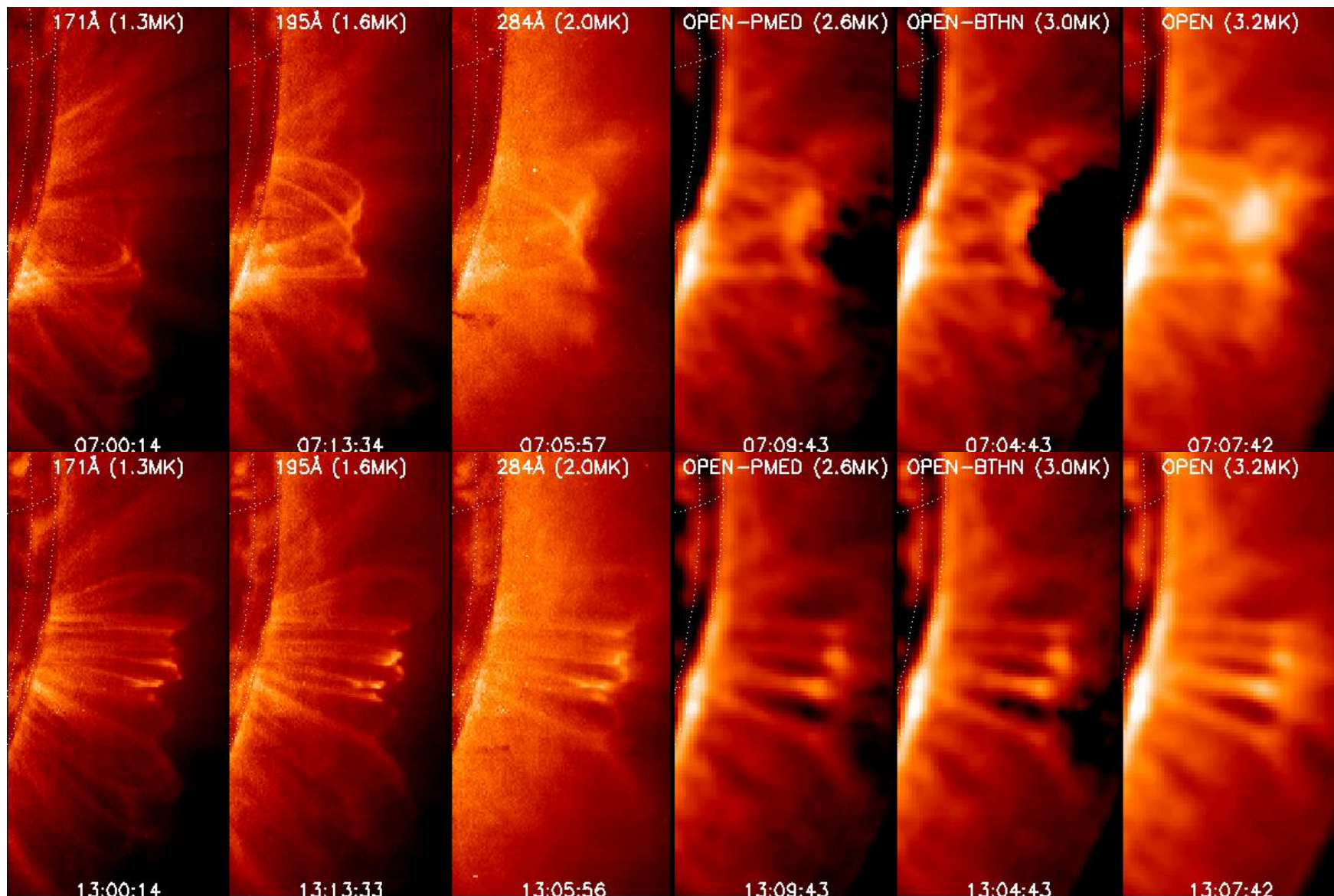
2.0 MK

2.6 MK

3.0 MK

3.2 MK

07:00







# ‘Hot’ Diffuse/Spiky Features in SXI & SXT

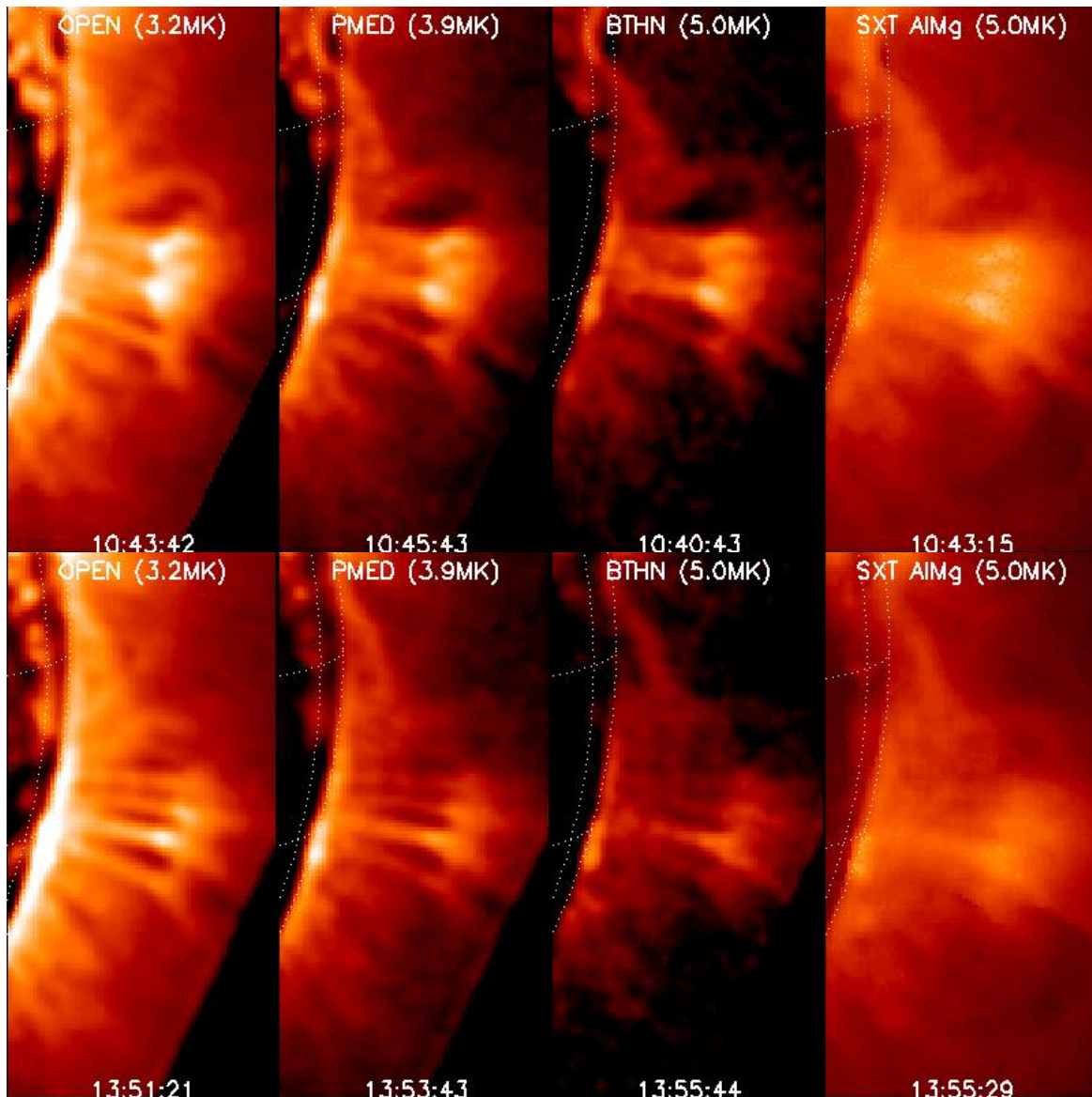
3.2 MK

3.9 MK

5.0 MK

5.0 MK

10:40

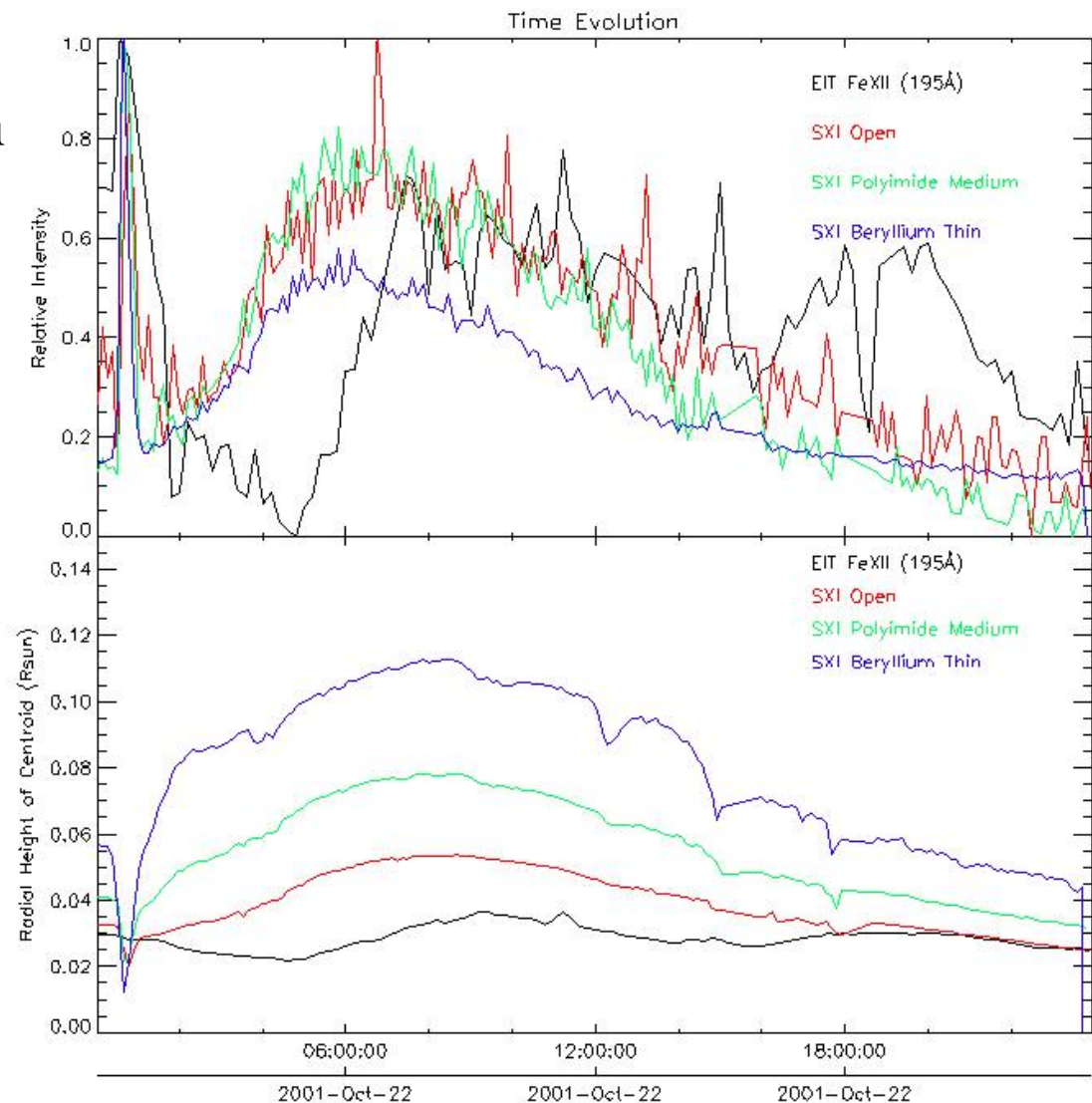




# Light Curves



- Boxed region:
  - 10x10 minute region
  - 1000 arcsec W
  - 250 arcsec S
- Intensity curves normalized for max dynamic range
- ~2 hr delay before loops ‘light-up’ in EIT FeXII

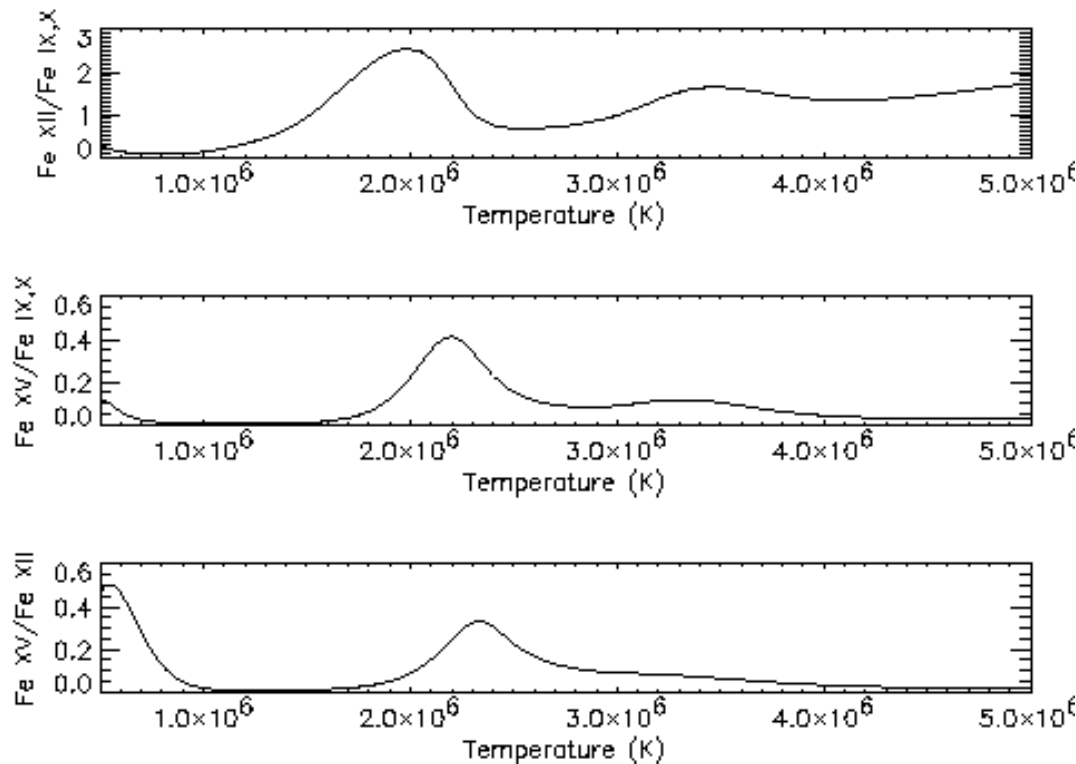




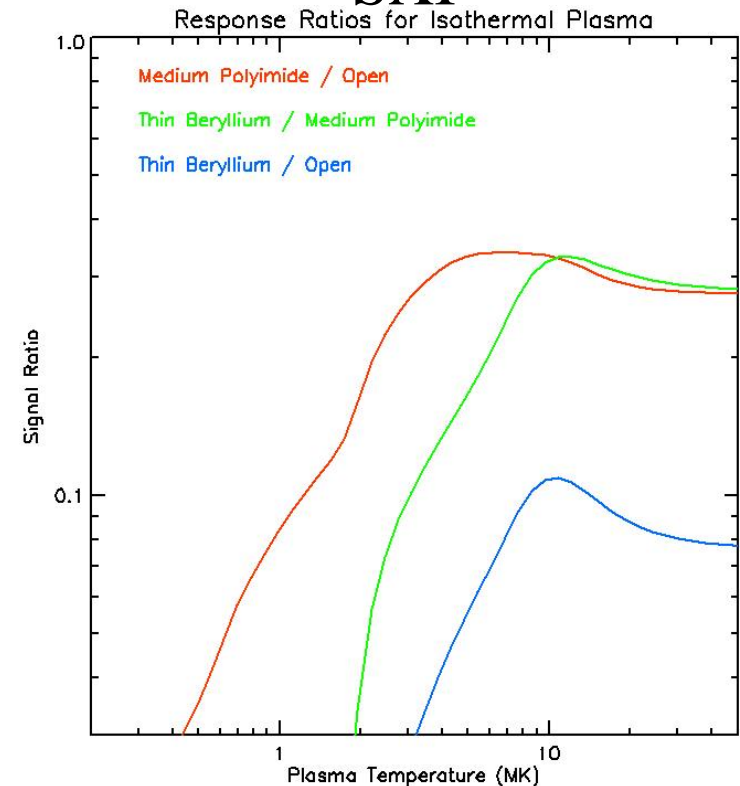
# Filter Ratio Temperature Method



## EIT



## SXI

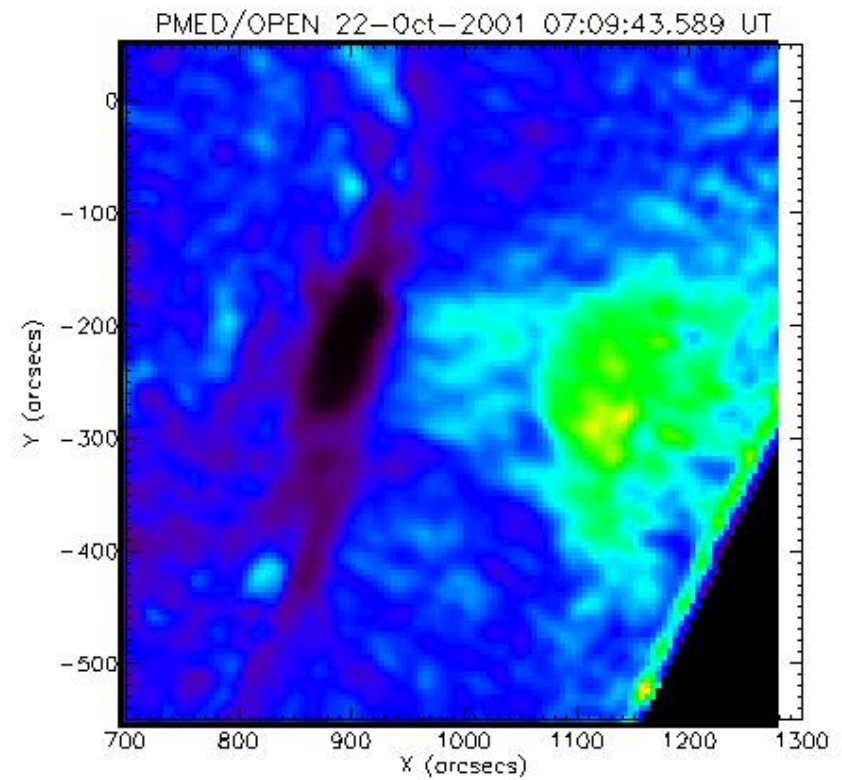
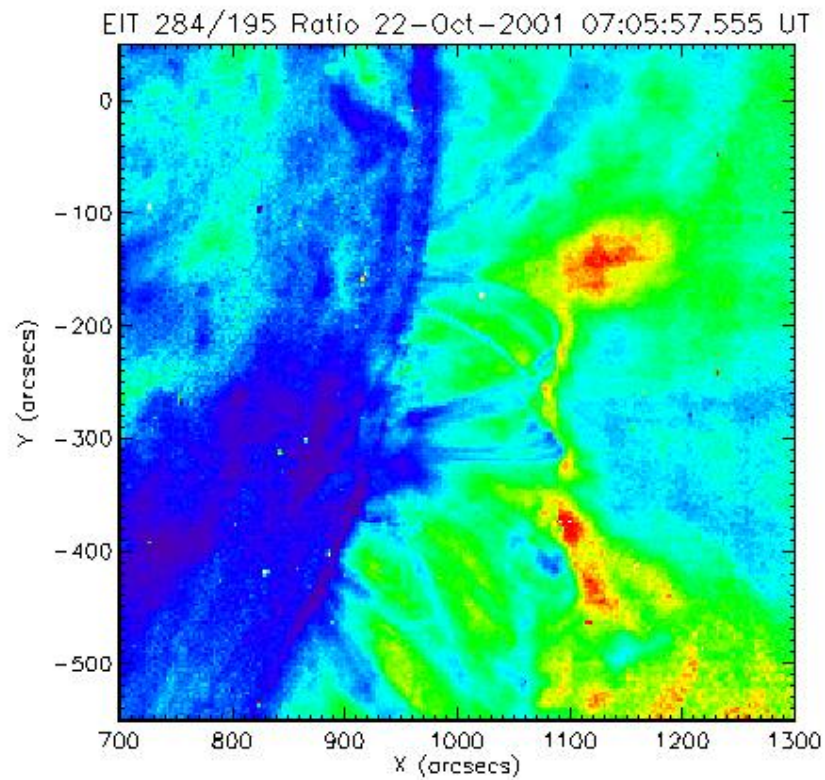
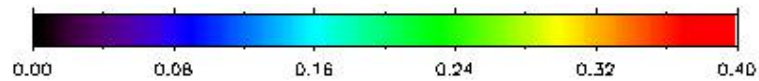


- EIT provides good temperature resolution but is limited to narrow ranges
- SXI provides wider range of temperature determination, but still has non-unique solutions





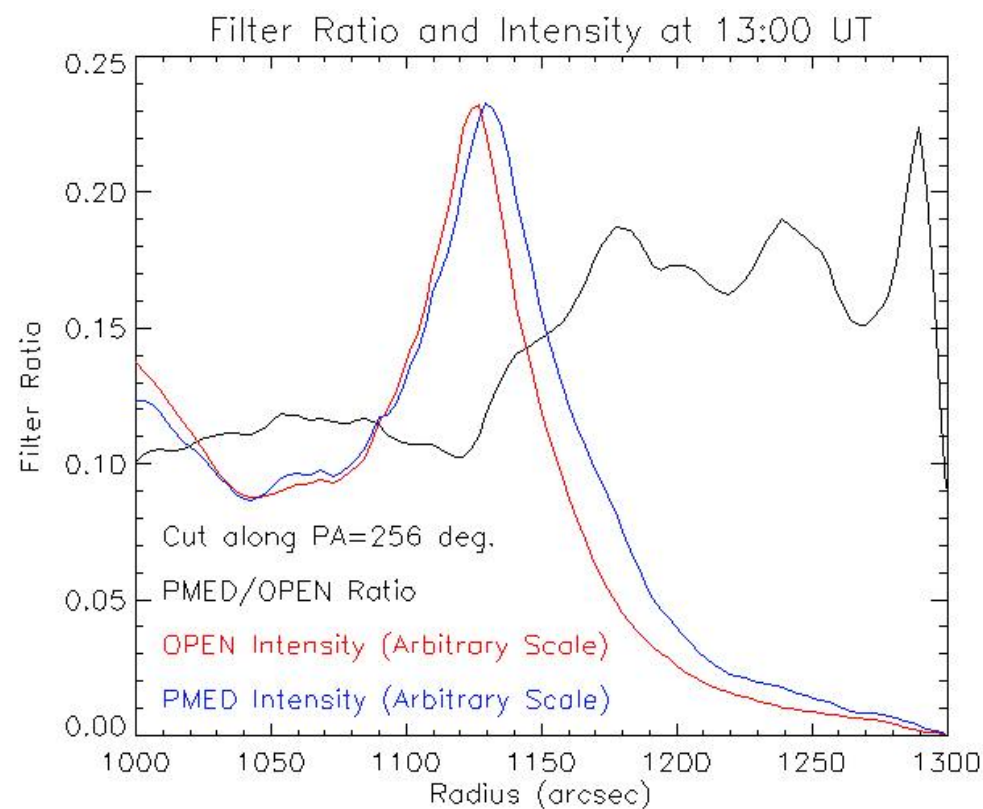
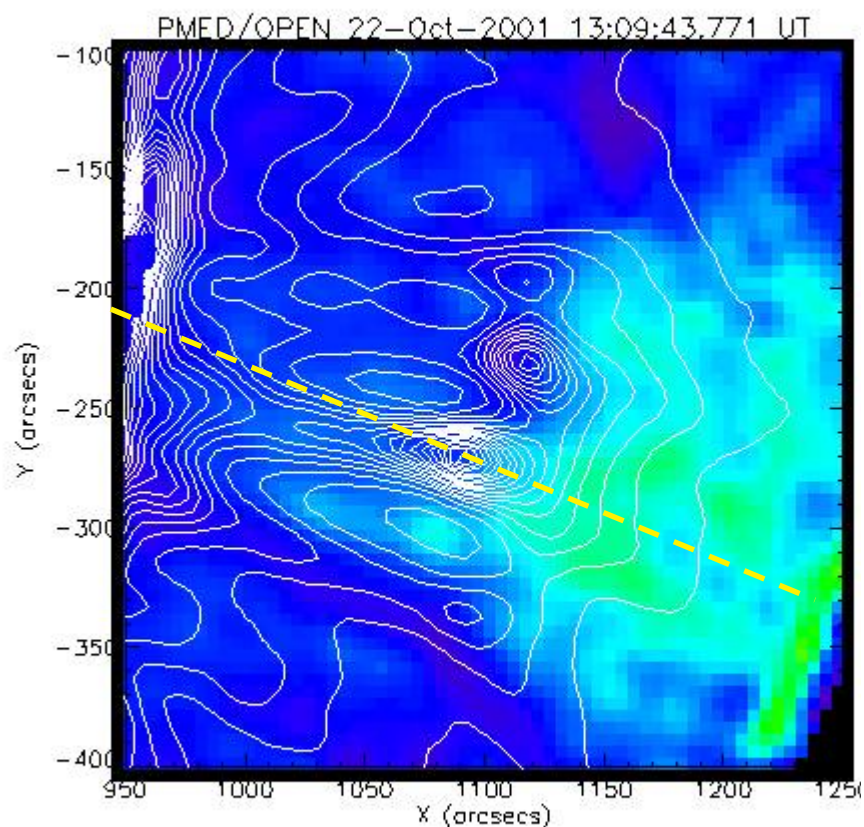
# EIT and SXI Filter Ratios





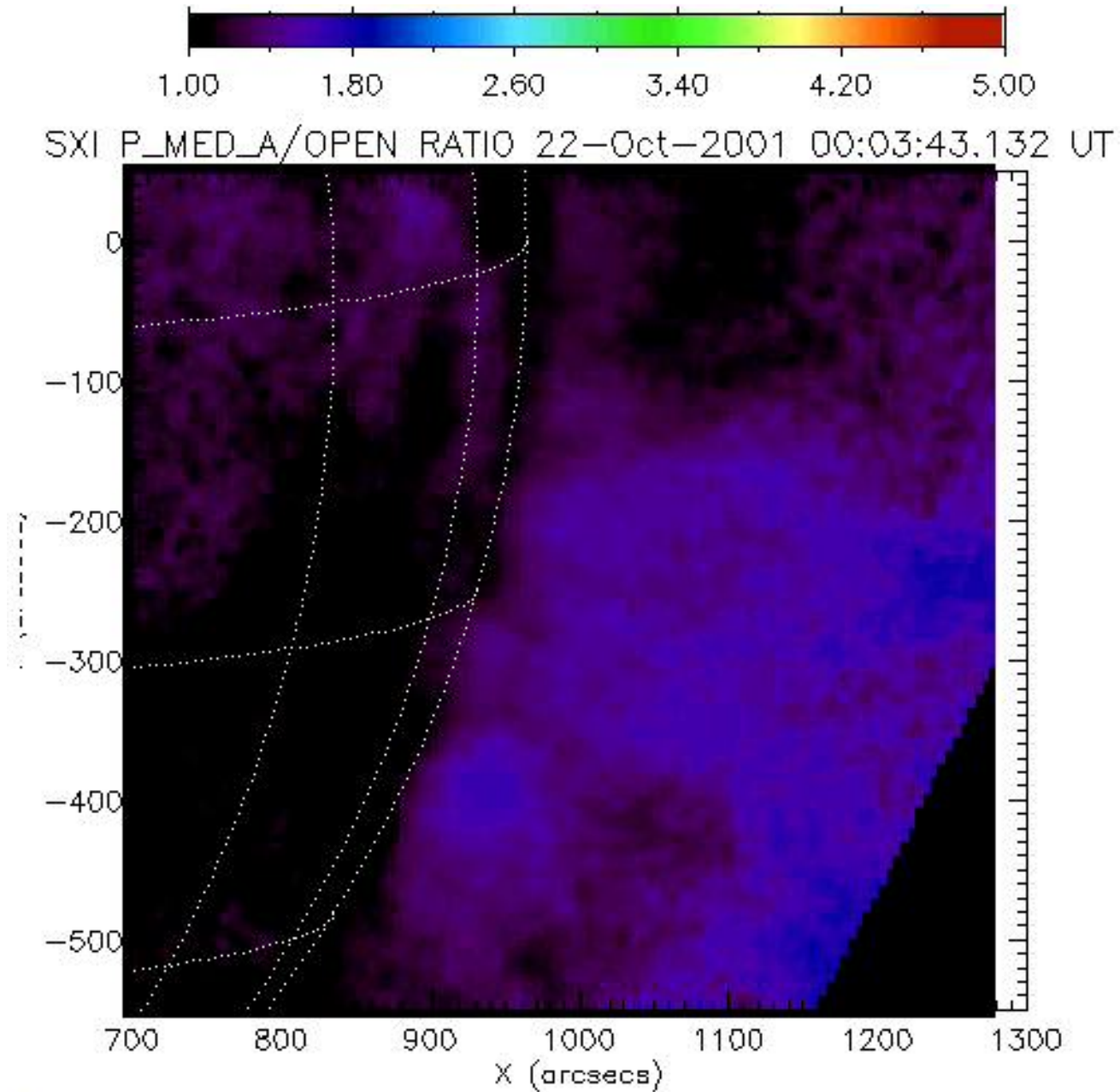


# Peak Emission is Below Peak Temperature





# Filter Ratio Movies?





# Conclusion



- What is SXI telling us about:
  - Spiky arcades (McKenzie & Hudson, 1999)?
  - Diffuse hot sources/'horns' (Warren *et al.*, 1999)?
  - Loop-top HXR sources (Nitta *et al.*, 2001)?
  - Cusps? SXI saw several, but only one on the limb.
- SXI is well poised to address many research issues given its cadence and continuity in multiple spectral bands
  - SXI bridges the spectral gap between EIT and SXT
  - SXI data, in combination with EIT and SXT offers great potential to address issues with post-flare systems